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'SCHMIDT HAMMER REBOUND' USERS GUIDE: IBM-PC/AT COMPUTER CALCULATION OF UNIAXIAL COMPRESSIVE STRENGTH USING THE SCHMIDT HAMMER

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'SCHMIDT HAMMER REBOUND' USERS GUIDE: IBM-PC/AT COMPUTER CALCULATION OF UNIAXIAL COMPRESSIVE STRENGTH USING THE SCHMIDT HAMMER

by

M. Issard* and T.R.C. Aston**

SUMMARY

This report describes the program 'SCHMIDT HAMMER REBOUND' which calculates the uniaxial compressive strength of rock using Schmidt hammer rebound index values. The program is written in BASIC A Version 3.10 for an IBM-PC/AT.

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"REBOND DU MARTEAU DE SCHMIDT" GUIDE DE L'USAGER: CALCUL DE LA RÉSISTANCE À LA COMPRESSION UNIAXIALE À L'AIDE DU MARTEAU DE SCHMIDT SUR ORDINATEUR IBM-PC/AT

par

M. Issard* et T.R.C. Aston**

RÉSUMÉ

Le présent rapport décrit le programme "Rebond du marteau de Schmidt" (Schmidt Hammer Rebound) qui permet de calculer la résistance à la compression uniaxiale de la roche à l'aide de nombres-indices du rebond du marteau de Schmidt. Ce programme est écrit en langage BASIC A Version 3,10 pour un ordinateur IBM-PC/AT.

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INTRODUCTION

The Schmidt hammer was originally developed to determine the surface hardness of concrete, but has subsequently been used to obtain a simple field index for rock/strata exposures (1,2). Essentially, the instrument consists of a plunger which is released by a spring and impacts against the rock surface. The rebound distance of the plunger is then read directly from a numerical scale reading between 0 and 80. A series of calibration curves were obtained experimentally by relating the logarithm of the 28-day cube strength of concrete against the hammer rebound number and this is now generally accepted by the construction industry (2). A similar set of curves have been produced for rock (1), Figure 1, and the relationship confirmed by other workers (3,4).

A computer program 'SCHMIDT HAMMER REBOUND' has been written at the Cape Breton Coal Research Laboratory which calculates the uniaxial compressive strength of the sample from the Schmidt hammer (Type L) field index value. The program can accommodate calculations based on five different hammer orientations and presents both the input data and final results in an orderly and easily readable format.

The 'SCHMIDT HAMMER REBOUND' program is written for use on an IBM-PC/AT microcomputer using the BASIC A Version 3.10 language. The program is conveniently run using a 360 kB diskette and an EPSON FX100 Dot Matrix Printer. The user is expected to be familiar with the operation of microcomputers and the concept of Schmidt hammer rebound testing.

A source listing of the program (Appendix A) is given along with an example of the output format.

SCHMIDT HAMMER REBOUND CALCULATION

In Figure 1, the curves (or lines) which allow the derivation of the uniaxial compressive strength from the Schmidt hammer field index can be described by equation 1:

$$\text{Log } \sigma_c = m(x - a) + 1 \qquad \text{Eq 1}$$

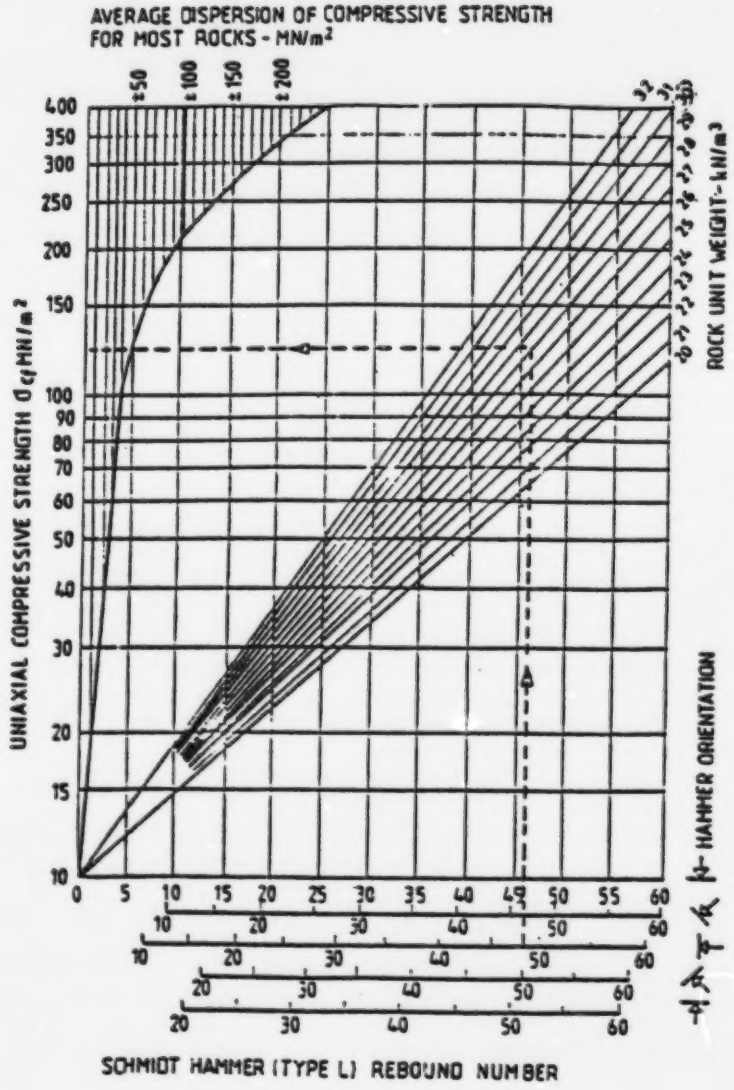

Figure 1 - Relationship between Schmidt hammer rebound number and the uniaxial compressive strength of rock (1)

where, m - slope of the curve
x - Schmidt hammer rebound number
a - x-axis intercept

The uniaxial compressive strength of a rock type is dependent upon its density and this is reflected in the slope of the curve (or line). As the density of the rock type increases, the slope of the corresponding curve also increases.

The slope of the curve was calculated for each of the five different hammer orientations given in Figure 1.

ERRORS AND INACCURACIES

Errors and inaccuracies with the Schmidt hammer are associated with the variability of the test techniques and conditions: a function of the hammer and the state of the rock surface. A worn hammer for instance can give a variable energy impact. The hammer is designed to function in a horizontal direction and corrections must be made for alternative angles, Figure 1. Unreliable results can occur in weaker rocks when the rock surface is wet, contains gouge/grit or if a joint is near the surface (2). A detailed statistical analysis (5) has shown that a good correlation can be obtained provided a minimum of five impacts at each measurement point are carried out and the highest rebound value at each point selected.

The 'SCHMIDT HAMMER REBOUND' program is based on Figure 1, but in order to obtain sufficient resolution for digitization, the diagram was magnified five times using photocopy techniques. Inaccuracies may therefore exist due to the distortions which occur during photocopying. In addition, Figure 1 incorporates an estimation of possible error which ranges between 30 and 50% of the calculated value.

PROGRAM USE

The 'SCHMIDT HAMMER REBOUND' program has a user friendly menu style operating system. The menu contains the following options:

CREATE NEW FILE
CALCULATE PREVIOUS FILE
END SESSION

The 'CREATE NEW FILE' option only allows new files to be created into which the data is stored on either floppy or hard disk. At present, up to 45 data points (impact rebound values) can be input to a data file, although alteration of the dimension statement (line 360) would allow up to several hundred data points to be used. This option cannot be used to calculate the results or print the output data.

To run the program, the 'CALCULATE PREVIOUS FILE' option must be used. If a new data file has just been created, this option is accessed and executed and the results output on the EPSON FX100 printer. The output file is not shown on the screen. If an old data file is required to be run, this option is also used for access and execution. An example of the output data format is given in Table 1.

To exit the program, the 'END SESSION' option is used.

ACKNOWLEDGEMENTS

The authors would like to acknowledge the discussions undertaken with and help provided by Mr. Hung Nguyen, a CO-OP student employed at the Cape Breton Coal Research Laboratory, in writing the program for use on the IBM-PC/AT.

CAPE BRETON COAL RESEARCH LABORATORY

PAGE 1 OF 1

LOCATION: LABORATORY

DATE: AUG 8/86 # OF TESTS: 10 FILE NAME: REPORT

SAMPLE DESCRIPTION: SANDSTONE

ROCK DENSITY: 2.5 g/cc HAMMER DIRECTION: H

TEST #	REBOUND NUMBER	UNIAXIAL COMPRESSIVE STRENGTH(MN/m^2)
1	35.0	64.34
2	41.0	88.53
3	37.0	71.56
4	29.0	46.76
5	36.0	67.86
6	43.0	98.47
7	40.0	83.93
8	29.0	46.76
9	36.0	67.86
10	40.0	83.93

MEAN VALUES

MEAN SCHMIDT HAMMER REBOUND NUMBER = 37
MEAN UNIAXIAL COMPRESSIVE STRENGTH = 72.00

Table 1 - Output data format

REFERENCES

1. Deere, D.U. and Miller, R.P. 'Engineering classification and index properties of intact rock'; Air Force Weapons Laboratory Report AFWL-65-16; Kirkland, New Mexico; 1966.
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3. Rankilov, P.R. 'A suggested field system of logging rock cores for engineering purposes'; Bull. Assoc. Eng. Geol.; Vol. II; pp. 247-258; 1974.
4. Carter, P. and Sneddon, M. 'Comparison of Schmidt hammer, point load and unconfined compression tests in carboniferous strata'; Rock Engineering; British Geotechnical Society; Newcastle-upon-Tyne, pp. 197-210; 1977.
5. Poole, R.W. and Farmer, I.W. 'Consistency and repeatability of Schmidt hammer rebound data during testing'; Int. J. Rock. Mech. Min. Sci.; Vol. 18; pp. 229-234; 1980.

APPENDIX A

```
10 REM  ************************************************************
20 REM  *                                                          *
30 REM  *                  SCHMIDT HAMMER REBOUND                  *
40 REM  *                  ----------------------                  *
50 REM  *                                                          *
60 REM  *    THIS PROGRAM PROVIDES THE USER WITH A SERVICE THAT ALLOWS *
70 REM  * THE STORAGE OF DESCRIPTIVE AND NUMERICAL DATA AND A PRINT OUT *
80 REM  * OF CALCULATED RESULTS OF SCHMIDT HAMMER REBOUND DATA,      *
90 REM  * PROVIDED BY THE STRATA MECHANICS GROUP OF THE CAPE BRETON  *
100 REM * COAL RESEARCH LABORITORIES, 210 GEORGE ST., SYDNEY, N.S.   *
110 REM *                                                          *
120 REM *                                                          *
130 REM ************************************************************
140 REM
150 CLS
160 LOCATE 5,27
170 PRINT "CORRELATION BETWEEN"
180 LOCATE 7,25
190 PRINT "SCHMIDT HAMMER REBOUND"
200 LOCATE 9,35
210 PRINT "AND"
220 LOCATE 11,22
230 PRINT "UNIAXIAL COMPRESSIVE STRENGTH"
240 LOCATE 23,1
250 INPUT "HIT RETURN TO CONTINUE...",P$
260 ON ERROR GOTO 3770
270 CLS
280 PRINT " DO YOU WISH TO VIEW THE COMMENTS AND INSTRUCTIONS SECTION?"
290 INPUT " INPUT (Y) OR HIT RETURN TO CONTINUE...";J$
300 IF J$="Y" OR J$="y" THEN 310 ELSE 350
310 INPUT " INPUT YOUR NAME ";V$:GOSUB 3850
320 REM
330 REM ----THIS SECTION DIMENSIONS REQUIRED VARIABLES----.
340 REM
350 DIM A$(40),B$(8),C$(15),N$(3)
360 DIM A(45),B(1),C(45),I(10),Y(45)
370 K1=15:Z=-14:M1=1:K=25:N=1:A1=0:A2=0:S=0:J=0
380 REM
390 REM ----MENU SERVICES AVAILABLE (SEE COMMENTS)----.
400 REM
410 CLS
420 PRINT TAB(16);"----------------------MENU----------------------"
430 PRINT TAB(16);"(1) .....  CREATE NEW FILE ....."
440 PRINT TAB(16);"(2) .....  CALCULATE PREVIOUS FILE ....."
450 PRINT TAB(16);"(3) .....  END SESSION ....."
460 PRINT TAB(16);"-----------------------------------------------"
470 REM
480 IF J$="Y" OR J$="y" THEN RETURN
490 PRINT " "
500 INPUT "                  INPUT SERVICE # ";Q
510 IF Q=1 THEN 540 ELSE 1610
520 CLOSE #1: CLOSE #2
530 KILL I$
540 CLS
```

```
550 PRINT " INPUT FILENAME."
560 INPUT " THE FILENAME MUST BE LESS THAN 9 CHARACTERS!!! ";F$
570 IF LEN(F$) > 8 THEN 540
580 GOSUB 4770
590 I$ = "B:" + F$
600 OPEN "A",#2,I$
610 CLOSE #2
620 OPEN "I",#1,"B:INDEX"
630 IF EOF(1) GOTO 710
640 INPUT #1,L$
650 IF L$ <> F$ THEN 630
660 PRINT " "
670 PRINT "ERROR : FILE ";F$;" ALREADY EXIST IN INDEX FILE PLEASE RE-ENTER"
680 GOSUB 3300
690 CLOSE #1
700 GOTO 540
710 CLOSE #1
720 PRINT " "
730 OPEN "B:INDEX" FOR APPEND AS #1
740 OPEN I$ FOR APPEND AS #2
750 INPUT " INPUT LOCATION ";A$
760 INPUT " INPUT SAMPLE DESCRIPTION ";B$
770 INPUT " INPUT DATE SAMPLED ";C$
780 INPUT " INPUT # OF DATA POINTS ";A
790 IF A<=0 THEN 780
800 Q=A
810 LOCATE 8,1
820 PRINT " "
830 PRINT " THE ROCK DENSITY CAN BE ENTERED IN UNITS OF (g/cm^3) OR (kg/m^3)."
840 PRINT " "
850 PRINT " (1)..... g/cm^3 ....."
860 PRINT " (2)..... kg/m^3 ....."
870 PRINT " "
880 LOCATE 13,1
890 PRINT "
900 LOCATE 13,1
910 INPUT " INPUT THE NUMBER CORRESPONDING TO YOUR INPUT UNITS ";B
920 IF B>2 THEN 810
930 IF B<=0 THEN 810
940 IF B=2 THEN X=.009806 ELSE IF B=1 THEN X=9.806
950 PRINT " "
960 PRINT " INPUT THE ROCK DENSITY."
970 PRINT " THE DENSITY MUST BE BETWEEN  2 - 3.3 g/cc"
980 PRINT "                    OR BETWEEN  2000 - 3300 kg/m^3."
990 INPUT " INPUT ROCK DENSITY ";T
1000 L=T*X
1010 L=CINT(L)
1020 PRINT " "
1030 IF L<20 THEN 2520
1040 IF L>32 THEN 2520
1050 INPUT " IS THIS INFORMATION CORRECT (Y) OR (N) ";G$
1060 IF G$="Y" OR G$="y" THEN 1070 ELSE 520
1070 PRINT #1, F$
1080 CLOSE #1
```

```
1090 REM
1100 REM ----HAMMER ORIENTATION----.
1110 REM
1120 CLS
1130 PRINT " THE UNIAXIAL COMPRESSIVE STRENGTH IS DIRECTLY PROPORTIONAL TO "
1140 PRINT " THE HAMMER ORIENTATION. INPUT THE LETTER(S) WHICH CORRESPOND "
1150 PRINT " TO THE HAMMER ORIENTATION."
1160 PRINT " "
1170 PRINT "  (VD)..... VERTICALLY DOWN IMPACT DIRECTION"
1180 PRINT "  (SD)..... SLOPED DOWN AT 45 DEG. IMPACT DIRECTION"
1190 PRINT "  (H)..... HORIZONTAL IMPACT DIRECTION"
1200 PRINT "  (SU)..... SLOPED UP AT 45 DEG. IMPACT DIRECTION"
1210 PRINT "  (VU)..... VERTICALLY UP IMPACT DIRECTION"
1220 PRINT " "
1230 INPUT " HAMMER ORIENTATION ";N$
1240 IF N$="VD" THEN 1330 ELSE 1250
1250 IF N$="SD" THEN 1330 ELSE 1260
1260 IF N$="H"  THEN 1330 ELSE 1270
1270 IF N$="SU" THEN 1330 ELSE 1280
1280 IF N$="VU" THEN 1330 ELSE 1290
1290 PRINT " "
1300 PRINT "ERROR : NO SUCH HAMMER ORIENTATTION , RE-ENTER LETTER(S)"
1310 GOSUB 3300
1320 GOTO 1120
1330 WRITE #2,A$,B$,C$,A,B,T,N$,F$
1340 CLOSE #2:CLS
1350 W$ = I$ + ".A"
1360 OPEN W$ FOR APPEND AS #3
1370      I=0
1380      I=I+1
1390      IF I <= A THEN 1400 ELSE 1450
1400      CLS
1410      A(I)=I
1420      PRINT " INPUT THE SCHMIDT HAMMER REBOUND NUMBER, FOR SAMPLE # ";I:INPUT " ";C(I)
1430      IF (C(I)<10) OR (C(I)>60) THEN 4540
1440      GOTO 1380
1450 GOSUB 3420
1460      FOR I = 1 TO A
1470      PRINT TAB(27);A(I);TAB(43);C(I)
1480      IF I=K1 THEN 1490 ELSE 1510
1490      IF I=A THEN 1530
1500      GOSUB 3460:GOSUB 3420
1510      NEXT
1520 PRINT " "
1530 PRINT "                          END OF DATA"
1540 PRINT "                          ----------"
1550 GOSUB 3460
1560      FOR I = 1 TO A
1570      PRINT #3, A(I), C(I)
1580      NEXT
1590 CLOSE #3
1600 GOTO 370
1610 IF Q=2 THEN 1620 ELSE 3400
1620 CLS: INPUT " DO YOU WISH TO VIEW THE INDEX (Y) OR (N) ";P$
```

```
1630 IF P$="N" OR P$="n" THEN 2200
1640 Q$ = " "
1650 X = 1
1660 CLS
1670 OPEN "I",#1,"B:INDEX"
1680 GOSUB 3600
1690 IF EOF(1) THEN GOTO 1730 ELSE GOSUB 3630
1700 INPUT #1, F$: X = X + 1
1710 PRINT TAB(20);F$
1720 GOTO 1690
1730 CLOSE #1
1740 PRINT " ":PRINT " ":PRINT " "
1750 IF Q$="Y" OR Q$="y" THEN 3750
1760 INPUT " WANT A CLOSER LOOK AT A FILE (Y) OR (N) ";U$
1770 IF U$="Y" OR U$="y" THEN 1780 ELSE 2170
1780 PRINT " "
1790 INPUT " INPUT FILENAME ";F$
1800 GOSUB 4770
1810 OPEN "I" , #1 , "B:INDEX"
1820 IF EOF(1) GOTO 1850
1830 INPUT #1,L$
1840 IF L$=F$ THEN 1880 ELSE 1820
1850 PRINT " ":PRINT"ERROR : NOT EXIST IN INDEX FILE , RE-ENTER "
1860 GOSUB 3300:CLS
1870 CLOSE #1 : GOTO 1780
1880 CLOSE #1
1890 I$="B:"+F$
1900 OPEN "I",#2,I$
1910 GOSUB 3670
1920 PRINT " "
1930 INPUT #2,A$,B$,C$,A,B,T,N$,F$
1940 IF LEN(A$)>15 THEN 1950 ELSE 1960
1950 PRINT TAB(1);LEFT$(A$,15);:GOTO 1970
1960 PRINT TAB(1);A$;:
1970 PRINT TAB(18);C$;:
1980 IF LEN(B$)>25 THEN 1990 ELSE 2000
1990 PRINT TAB(30);LEFT$(B$,24);:GOTO 2030
2000 IF LEN(B$)<12 THEN 2010 ELSE 2020
2010 PRINT TAB(37);B$;:GOTO 2030
2020 PRINT TAB(30);B$:
2030 PRINT TAB(56);:PRINT USING "####.#";T;:PRINT TAB(65);F$
2040 IF LEN(A$)>15 THEN 2050 ELSE 2060
2050 PRINT TAB(1);RIGHT$(A$,LEN(A$)-15);:
2060 IF LEN(B$)>25 THEN 2070 ELSE 2080
2070 PRINT TAB(30);RIGHT$(B$,LEN(B$)-24)
2080 IF LEN(A$)>15 THEN 2090 ELSE 2100
2090 PRINT TAB(30);" "
2100 CLOSE #2
2110 PRINT " ": PRINT " ": PRINT " "
2120 INPUT " DO YOU WISH TO CALCULATE AND RECEIVE A COPY OF THIS FILE (Y) OR (N) ";P$
2130 IF P$="N" OR P$="n" THEN 2140 ELSE 2270
2140 PRINT " "
2150 INPUT " WANT TO LOOK AT ANOTHER FILE (Y) OR (N) ";Q$
2160 IF Q$="Y" OR Q$="y" THEN 1650 ELSE 2170
```

```
2170 PRINT " "
2180 INPUT " DO YOU WISH TO CALCULATE A FILE AND RECEIVE A COPY (Y) OR (N) ";P$
2190 IF P$="Y" OR P$="y" THEN 2200 ELSE 370
2200 PRINT " "
2210 INPUT " INPUT DATA FILE FOR CALCULATION ";F$
2220 REM
2230 CLS
2240 REM ----SELECTS FILE AND DETERMINES # OF PAGES----.
2250 REM
2260 I$="B:"+F$
2270 CLS
2280 OPEN "I",#2,I$
2290 INPUT #2,A$,B$,C$,A,B,I,N$,F$
2300 CLOSE #2: FOR S = 25 TO 100 STEP 25
2310           IF S>=A THEN 2330
2320           NEXT
2330 M1=S/25
2340 REM
2350 REM ----READS AND CALCULATES SCHMIDT HAMMER DATA FOR REPORT----.
2360 REM
2370 W$=I$+".A"
2380 OPEN "I",#3,W$
2390 PRINT "PLEASE WAIT"
2400 IF B=2 THEN X=.009806 ELSE IF B=1 THEN X=9.806
2410 IF B=2 THEN O$=" kg/m^3" ELSE IF B=1 THEN O$=" g/cc"
2420 J=I*X
2430 J=CINT(J)
2440 R$="B:"+N$
2450 OPEN "I",#1,R$
2460 INPUT #1,S
2470 IF EOF(1) THEN 2510
2480 INPUT #1,H,M
2490 IF H=J THEN 2580
2500 GOTO 2470
2510 CLOSE #3
2520 CLS
2530 PRINT " YOUR DENSITY IS OUT OF RANGE FOR THIS PROGRAM. "
2540 PRINT " UNFORTUNATELY, THIS FILE IS OF NO USE."
2550 CLOSE #1:CLOSE #2:KILL I$
2560 GOSUB 3300
2570 GOTO 370
2580 CLOSE #1
2590 X=0
2600 IF EOF(3) THEN 2670
2610 X=X+1
2620 INPUT #3,A(X),C(X)
2630 Y(X)=M*C(X)
2640 Y(X)=2.302585*Y(X):Y(X)=EXP(Y(X))*10
2650 A1=A1+C(X)/A:A2=A2+Y(X)/A
2660 GOTO 2600
2670 CLOSE #3
2680 REM
2690 REM ----PRINTS HEAD LINES FOR EACH PAGE IN REPORT----.
2700 REM
```

```
2710 LPRINT CHR$(15)
2720 WIDTH "LPT1:",132
2730 LPRINT TAB(16);" ";:GOSUB 3340
2740 LPRINT "CAPE BRETON COAL RESEARCH LABORATORY";:GOSUB 3350
2750 LPRINT " "
2760 LPRINT TAB(80);"PAGE";N;" OF ";M1
2770 LPRINT " "
2780 LPRINT TAB(3);"LOCATION:";TAB(14);A$
2790 LPRINT " "
2800 LPRINT TAB(3);"DATE: ";C$;TAB(35);"# OF TESTS:";A;TAB(60);"FILE NAME: ";F$
2810 LPRINT " "
2820 LPRINT TAB(3);"SAMPLE DESCRIPTION:";TAB(25);B$
2830 LPRINT " "
2840 LPRINT TAB(3);"ROCK DENSITY:";TAB(16);I;D$;TAB(41);"HAMMER DIRECTION: ";N$
2850 LPRINT " "
2860 LPRINT " "
2870 LPRINT TAB(30);"TEST # ";TAB(44);"REBOUND";TAB(58);"UNIAXIAL COMPRESSIVE"
2880 LPRINT TAB(44);"NUMBER";TAB(58);"STRENGTH(MN/m^2)"
2890 LPRINT " ":LPRINT " "
2900 GOSUB 3330
2910 LPRINT ".";TAB(65);"."
2920 GOSUB 3350
2930 IF N>1 THEN RETURN
2940 REM
2950 REM ----PRINTS LINE BY LINE RESULTS FOR SCHMIDT HAMMER REBOUND TESTS----.
2960 REM
2970 LPRINT " "
2980      FOR I = 1 TO A
2990      LPRINT TAB(30);:LPRINT USING "####";A(I);:LPRINT TAB(47);:
3000      LPRINT USING "##.#";C(I);:LPRINT TAB(66);:LPRINT USING "###.##";Y(I)
3010      IF I=K THEN 3020 ELSE 3040
3020      N=N+1:IF I=A THEN 3040
3030      GOSUB 3370:GOSUB 2730:K=K+25
3040      NEXT
3050 GOSUB 3330
3060 LPRINT ".";TAB(65);"."
3070 GOSUB 3350
3080 REM
3090 REM ----PRINTS FINAL AVERAGES TO REPORT----.
3100 REM
3110 LPRINT TAB(10);"MEAN VALUES"
3120 LPRINT " "
3130 LPRINT TAB(1);"MEAN SCHMIDT HAMMER REBOUND NUMBER = ";:
3140 LPRINT USING "##";A1
3150 LPRINT TAB(1);"MEAN UNIAXIAL COMPRESSIVE STRENGTH = ";:
3160 LPRINT USING "####.##";A2
3170 A1=0:A2=0
3180 GOTO 370
3190 CLS
3200 PRINT TAB(25);"TEST #";TAB(35);"SCHMIDT REBOUND #"
3210 PRINT TAB(25);"--------------------------"
3220       FOR L=Z TO Q
3230       PRINT TAB(27);A(L);TAB(43);C(L)
3240       IF L=K1 THEN RETURN ELSE 3250
```

```
3250        NEXT
3260 PRINT " "
3270 PRINT "                        END OF DATA"
3280 PRINT "                        ----------"
3290 GOTO 3590
3300 PRINT " "
3310 INPUT "                                    ...HIT RETURN TO CONTINUE ";T$
3320 RETURN
3330 H$=CHR$(9)
3340 LPRINT H$H$;CHR$(27)"-1";:RETURN
3350 LPRINT CHR$(27);"-0"
3360 RETURN
3370 LPRINT CHR$(27)"C"CHR$(24)
3380 LPRINT CHR$(12)
3390 RETURN
3400 CLS:IF Q=3 THEN 3410 ELSE 370
3410 SYSTEM:END
3420 CLS
3430 PRINT TAB(25);"TEST #";TAB(36);"SCHMIDT REBOUND #"
3440 PRINT TAB(25);"---------------------------"
3450 RETURN
3460 PRINT " "
3470 INPUT "IS THERE ANY ERRORS IN THIS DATA (Y) OR (N) ";G$
3480 IF G$="Y" OR G$="y" THEN 3490 ELSE 3550
3490 PRINT " "
3500 INPUT " INPUT ERRORED TEST # ";J
3510 IF J>A THEN 4720
3520 IF J<=0 THEN 4720
3530 PRINT " INPUT THE SCHMIDT HAMMER REBOUND NUMBER, FOR SAMPLE # ";J;:INPUT " ";C(J)
3540 GOTO 3460
3550 Z=Z+15:GOSUB 3190
3560 GOSUB 3300
3570 CLS
3580 K1=K1+15
3590 RETURN
3600 PRINT TAB(20);"FILES"
3610 PRINT TAB(20);"-----":PRINT " "
3620 RETURN
3630 IF X MOD 15<>0 THEN RETURN
3640 INPUT "                        ...HIT RETURN TO CONTINUE";T$
3650 P=P+15
3660 CLS:GOSUB 3600:RETURN
3670 CLS
3680 PRINT TAB(15);"SCHMIDT HAMMER REBOUND # FILES"
3690 PRINT " "
3700 PRINT TAB(1);"LOCATION";TAB(21);"DATE";TAB(35);"DESCRIPTION";:
3710 PRINT TAB(55);"DENSITY";TAB(65);"FILE NAME"
3720 PRINT "------------------------------------------------------------------";:
3730 PRINT "----------"
3740 RETURN
3750 INPUT " WHICH FILE ";F$
3760 GOTO 1890
3770 RESET
3780 PRINT ERL;"   ";ERR
```

```
3790 PRINT "YOU HAVE MADE AN ERROR OR FORGOT TO TURN ON THE PRINTER !!!"
3800 PRINT " "
3810 PRINT " OR YOU MAY HAVE USED AN INVALID CHARACTER IN THE FILENAME."
3820 PRINT " "
3830 PRINT " ":GOSUB 3300
3840 CLS:RESUME 370
3850 CLS
3860 PRINT TAB(8);"HELLO THERE ";V$;"!!, MY NAME IS SHR. READ THE FOLLOWING "
3870 PRINT TAB(8);"TO BECOME FAMILIAR WITH ME."
3880 PRINT " "
3890 PRINT TAB(8);"                    INSTRUCTIONS AND COMMENTS"
3900 PRINT TAB(8);"                    -------------------------"
3910 PRINT " "
3920 PRINT TAB(8);"    THIS PROGRAM PROVIDES THE USER WITH A SERVICE THAT ALLOWS THE "
3930 PRINT TAB(8);" STORAGE OF DESCRIPTIVE AND NUMERICAL DATA AND A PRINT OUT OF "
3940 PRINT TAB(8);" CALCULATED RESULTS OF SCHMIDT HAMMER REBOUND DATA, PROVIDED BY THE"
3950 PRINT TAB(8);" CAPE BRETON COAL RESEARCH LABORITORIES, 210 GEORGE ST., SYDNEY, N.S."
3960 PRINT " "
3970 PRINT TAB(8);"    AFTER LOADING OF THIS PROGRAM, YOU WILL BE PROVIDED WITH A "
3980 PRINT TAB(8);" SERVICE MENU WHICH LOOKS LIKE THE FOLLOWING:"
3990 PRINT " "
4000 GOSUB 420
4010 GOSUB 3300:CLS
4020 PRINT " "
4030 PRINT "         INFORMATION ON THE SERVICE #'s AVAILABLE....."
4040 PRINT " "
4050 PRINT "    SERVICE #1 PROVIDES YOU WITH THE ABILITY TO CREATE A NEW FILE."
4060 PRINT " IT WILL PROMPT YOU FOR INFORMATION ABOUT THE FILE. FOR EXAMPLE, THE"
4070 PRINT " DATE SAMPLED, ROCK DENSITY AND HAMMER ORIENTATION. THE ROCK DENSITY"
4080 PRINT " MAY BE ENTERED IN UNITS OF g/cc OR kg/m^3 AND THE HAMMER ORIENTATION"
4090 PRINT " IS ONE OF FIVE OPTIONS (VERTICALLY DOWN, SLOPED DOWN, HORIZONTAL,"
4100 PRINT " SLOPED UP,VERTICALLY DOWN). AS WELL, IT WILL PROMPT FOR THE NUMER-"
4110 PRINT " ICAL DATA, SCHMIDT HAMMER REBOUND NUMBER. IF THE VALUE IS OUT OF "
4120 PRINT " RANGE (# <10 OR # >60), THE PROGRAM WILL INDICATE THIS TO YOU, AND"
4130 PRINT " THE VALUE WILL NOT BE SAVED. THIS WILL CONTINUE TO BE "
4140 PRINT " CARRIED OUT TO THE MAX. # OF DATA POINTS AS INPUTTED ."
4150 GOSUB 3300:CLS
4160 PRINT "    THE PROGRAM THEN ASKS IF ANY ERRORS HAVE BEEN MADE. IF THERE ARE"
4170 PRINT " ERRORS AND YOU ANSWER (Y) TO THE QUESTION, THEN YOU WILL BE PRO-"
4180 PRINT " VIDED WITH AN EDIT SERVICE.(NOTE- IT IS A GOOD PRACTICE TO CHECK "
4190 PRINT " DATA, EVEN IF YOU BELIEVE IT TO BE CORRECT.) THE PROGRAM WILL THEN"
4200 PRINT " SCROLL OUT 15 LINES OF DATA AT A TIME. IF ANY ERRORS HAVE BEEN DIS-"
4210 PRINT " COVERED, YOU MAY CORRECT THEM BY ENTERING THE SAMPLE # OF THE LINE "
4220 PRINT " TO BE CHANGED. YOU WILL THEN ENTER THE SCHMIDT HAMMER REBOUND NUMBER"
4230 PRINT " FOR THAT LINE. THIS PROCESS CAN CARRY ON AS LONG AS YOU ENTER (Y)"
4240 PRINT " TO THE EDIT QUESTION. IF YOU TYPE IN (N) TO THE EDIT QUESTION, THE"
4250 PRINT " 15 LINES OF CORRECTED DATA WILL SCROLL OUT ON THE SCREEN. YOU MAY"
4260 PRINT " THEN PRESS RETURN TO REVIEW ANY FURTHER LINES OF DATA, WHICH WILL"
4270 PRINT " SCROLL TO THE SCREEN. ONCE ALL LINES OF DATA HAVE BEEN REVIEWED,"
4280 PRINT " THE PROGRAM WILL RETURN TO THE SERVICE MENU."
4290 GOSUB 3300:CLS
4300 PRINT "    AT THIS POINT YOU HAVE THE CHOICE OF SELECTING THE PRINT OUT OF"
4310 PRINT " YOUR NEW FILE REPORT OR AN OLDER FILE REPORT. IF YOU SELECT SERVICE"
4320 PRINT " # 2, THE PROGRAM WILL PROCEED TO SCROLL UP A LIST OF ALL DATA FILES"
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4330 PRINT " AND THEIR DESCRIPTION, IF SO DESIRED. IF YOU WISH TO RECEIVE A COPY"
4340 PRINT " OF A REPORT, ANSWER THE QUESTIONS APPROPRIATELY. IF PROMPTED FOR"
4350 PRINT " THE NAME OF A FILE, BE SURE TO INPUT THE NAME CORRECTLY. IF INPUT"
4360 PRINT " INCORRECTLY, THE PROGRAM WILL RETURN WITH AN ERROR MESSAGE. MAKE"
4370 PRINT " SURE THE PRINTER IS TURNED ON AND PAPER IS ABOUT 1(cm) ABOVE PRINT-"
4380 PRINT " ING HEAD."
4390 PRINT "    AT ANY TIME YOU MAY SELECT ANY MENU # AND WHEN YOU ARE FINISHED"
4400 PRINT " A SESSION, SELECT # 3 FROM THE SERVICE MENU. "
4410 PRINT "    IT IS IMPORTANT TO NOTE THAT ANY CALCULATED RESULTS MAY BE"
4420 PRINT " ERRONEOUS TO A CERTAIN DEGREE. THE SCHMIDT HAMMER PROGRAM IS"
4430 PRINT " BASED UPON CALIBRATION CURVES , WHICH HAVE BEEN MAGNIFIED 5"
4440 PRINT " TIMES THEIR ORIGINAL SIZE. PHOTOCOPYING IS KNOWN TO DITORT THE "
4450 PRINT " ACTUAL DIMENSIONS OF FIGURES. ANOTHER SOURCE OF ERROR MAY EXIST"
4460 PRINT " IN THE PROGRAM CALCULATIONS. THE CALCULATIONS ARE DEPENDENT UPON"
4470 PRINT " THE SLOPE OF THE CURVES, WHICH WERE EXTRAPOLATED BY THE  "
4480 PRINT " PROGRAMMER. THIRDLY, THE ORIGINAL GRAPH ENCORPORATES AN ESTIMA-"
4490 PRINT "    MAKE SURE YOU ARE FAMILIAR WITH BACKING UP THE WORK DISK WITH A"
4500 PRINT " DUPLICATE DISK IN CASE OF A (CRASH) OR DAMAGE."
4510 PRINT "    HAVE A GOOD SESSION ";V$;" AND A GOOD DAY!!"
4520 J$= " "
4530 GOSUB 3300:CLS:RETURN
4540 PRINT " "
4550 PRINT " THIS VALUE IS OUT OF RANGE AND WILL NOT BE SAVED IN THE DATA FILE."
4560 PRINT " "
4570 PRINT " "
4580 U$="HOLD"
4590 T$="B:" + U$
4600 OPEN "A",#1,T$
4610 A=A-1: Q=Q-1
4620 WRITE #1,A$,B$,C$,A,B,T,N$,F$
4630 CLOSE #1
4640 KILL I$
4650 OPEN I$ FOR APPEND AS #2
4660 WRITE #2,A$,B$,C$,A,B,T,N$,F$
4670 CLOSE #2
4680 KILL T$
4690 INPUT " HIT RETURN TO CONTINUE WITH PROGRAM.....",T$
4700 CLS
4710 GOTO 1390
4720 PRINT " "
4730 PRINT " ERROR: NO SUCH TEST # EXISTS IN THIS FILE. RE-ENTER."
4740 PRINT " "
4750 GOSUB 3300
4760 GOTO 3490
4770 REM
4780 FL$=""
4790 FOR I = 1 TO LEN(F$)
4800 CH$=MID$(F$,I,1)
4810 IF CH$ >= "a" AND CH$ <= "z" THEN CH$=CHR$(ASC(CH$)-32)
4820 FL$=FL$+CH$
4830 NEXT I
4840 F$=FL$
4850 RETURN
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